National Park Service

National Park Service
U.S. Department of the Interior

NORTHEAST REGION
INVENTORY AND MONITORING PROGRAM

Product Specifications

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DRAFT

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Introduction

The National Park Service (NPS) Inventory and Monitoring (I&M) Program is in the initial stages of developing Product Specifications. The current specifications may change as the program develops, and especially as data management programs evolve. This document was written to provide cooperators/contractors with a straightforward list of deliverables that are required at the completion of each biological inventory project. Just as a reminder, all non-NPS science activities require a permit. The NPS Research Permit and Reporting System provides an online application.

Cooperators and contractors are to provide the following deliverables:

1. Species Data

Raw Data
Copies of all raw data, such as hand written field forms, must be submitted to the Northeast Coastal and Barrier Network Data Manager.

Species Inventory Database
All inventory and monitoring data must be provided in an MS Access relational database following the I&M Program's Natural Resource Database Template (http://science.nature.nps.gov/im/apps/template/index.htm). Database template have been developed for some Northeast Region inventory projects. Please contact Sara_Stevens@nps.gov for information on existing databases.

Each database must have a spatial component to it, and all cooperators must provide GPS coordinates for all fixed sampling locations (e.g. plots, transects, etc…) as well as any locations where rare, threatened or endangered species were found in the park. Cooperators are also encouraged to obtain GPS coordinates for observations obtained from general search areas or opportunistic sightings, but are not required to do so. Please review the GPS standard operating procedures for field data collection and the Spatial Data Guidelines if coverages, or shape files are being submitted in sections I and II of the appendix.

NPSpecies Database
All species data must be entered into the NPSpecies database. A single entry is required for each species documented during the inventory. Data can either be entered online or in a desktop version of the database. Please contact Sara Stevens for a login and password.

Data Dictionary
A data dictionary must be submitted with each database. A data dictionary describes in detail, each data field and allows future users to understand how the data was collected. See Data Dictionary Example in Section V of the appendices.

2. Metadata

Metadata is simply documentation of your data. Metadata provides details such as who created the data, for what purpose, and when. Think of putting your data in a library system, the metadata

document is actually the card in the card catalog, it describes what, who where, and when about the data.

The Federal Geographic Data Committee (FGDC) is the U.S. federal committee responsible for creating and maintaining the most widely adopted standard for metadata currently in use--the FGDC Content Standards for Digital Geospatial Metadata, commonly called the FGDC standard. The FGDC standard is like a style guide for metadata. It defines what information belongs in a metadata record and the order in which it is presented. The purpose of the FGDC standard is to provide a common definition for metadata for everyone to follow. Through use of a common standard, it becomes easier for those within and among different organizations to access data described through metadata.

For all NPS Inventory and Monitoring projects, Federal Geographic Data Committee (FGDC) compliant metadata must be provided with all spatial data files. And for all biological data sets (e.g. MS Access and Excel Databases), cooperators must follow the Biological Data Profile of the Content Standard for Digital Geospatial Metadata. FGDC compliant metadata must be parsed using the metadata parser provided by the FDGC (http://www.fgdc.gov). The metadata should be supplied as ASCII text with a txt extension, hypertext markup language with an html extension and standard general markup language with an sgml extension.

All cooperators should contact the NPS Field Technical Support Center (FTSC) at North Carolina State University for assistance in metadata development.

NPS Field Technical Support Center
Bill Slocumb
North Carolina State University
NCSU Campus Box 7106
Raleigh, NC 27695-7106
Email: bill_slocumb@ncsu.edu
Phone: 919-515-3432
Fax: 919-515-3439

3. Voucher Specimens

The Northeast Region I&M Program chooses to leave the issue of vouchering up to the discretion of the park where the inventory is taking place. An agreement on vouchering must be reached prior to initiating the inventory. All specimens regardless of their repository will remain the property of the National Park Service and are assumed to be on long-term loan to the housing institution/collection outside of the Service. It is mandatory that cooperators catalog all collected specimens in the Automated National Catalog System (ANCS+) and that all specimens are labeled with the appropriate NPS property label. See Section III of the Appendix for further guidance on Voucher Specimen Collection.

4. Reports

Progress Reports

Progress reports must be submitted digitally in MS Word format, and as paper copy if requested. Minimally, they will be due annually dependent upon the length and scope of the project. See Section IV of the Appendix for Progress Report Format and Content Guidelines.

Final Reports

A draft final report must first be submitted electronically in MS Word, and as paper copy if requested, to the Regional I&M Coordinator, the Network Coordinator and Network Data Manager for management and scientific review and comment. It must include methodology, analysis, results and discussion.

The final report must be submitted both on CD-ROM and in hard copy. See Section IV of the Appendix for Final Report Format and Content Guidelines. Cooperators are responsible for submitting all other required products with or prior to the final report.

5. Final Submission of all Deliverables

All deliverables mentioned above must be submitted on CD-ROM to the appropriate Northeast Region I&M Program contacts as well as to all parks involved. All CD's submitted must contain a "Readme" file providing the file name of each file on that CD and a brief description of each of those files. If possible, all deliverables should be provided on the same CD, including any Powerpoint presentations created for the project, digital photos taken during the project, etc…All files must be labeled clearly and be referred to in the accompanying "Readme" file.

APPENDIX

Section I	**Field Data Collection with Global Positioning Systems**
Section II	**Spatial Data format**
Section III	**Voucher Specimen Collection**
Section IV	**Report Guidelines**
Section V	**Database Dictionary**

Section I

Field Data Collection with Global Positioning Systems

Standard Operating Procedures and Guidelines

06/05/02

The purpose of this document is to address instrument settings, field operation, and data processing for GPS data collection and to make recommendations for standards in recording of positional data.

Definition of the Global Positioning System
GPS (Global Positioning System) is currently a constellation of 25 Department of Defense satellites that orbit the earth approximately every 12 hours, emitting signals to Earth at precisely the same time. The position and time information transmitted by these satellites is used by a GPS receiver to trilaterate a location coordinate on the earth using three or more satellites.

The satellites broadcast on two carrier frequencies in the L-band of the electromagnetic spectrum. One is the "L1" or 1575.42MHz and the other is "L2" or 1227.6MHz. On these carrier frequencies are broadcast codes, much like a radio or television station broadcast information on their channels (frequencies). The satellites broadcast two codes, a military-only encrypted Precise Position Service (PPS) code and a civil-access or Standard Position Service (SPS) code.

GPS Receivers
All commercially available consumer GPS receivers are SPS receivers. There are two basic types of SPS receivers, those that use the broadcasted code to do positioning (code-phase) and those that do carrier phase measurements (carrier-phase). PPS or P(Y)-Code (Rockwell PLGR and Trimble Centurion) receivers utilize the P(Y)-code broadcast on the L2 carrier frequency for positioning. This type of receiver is only available to the military and some government agencies.

Positional Data
The National Map Accuracy Standard (NMAS) published by the USGS is the NPS *minimum* standard for map data accuracy. Typically a GPS will provide much better accuracy then NMAS if it is used carefully and with full attention to the parameters that the user can set or track. To achieve a reasonable and reliable level of accuracy with a GPS, please use the parameter settings described below. Please note that different GPS units use different names for these parameters or define them slightly differently. The discussion below tries to accommodate for these differences. If you have any questions please contact Tim Smith at Tim_Smith@nps.gov or your regional GIS coordinator.

GPS Positional Accuracy
Positional accuracy for autonomous, code-phase, resource grade or C/A-code receivers range from 100 meters to less than 2 meters. Accuracy for carrier-phase units (commonly referred to as geodetic receivers) can be measured in millimeters.
Accuracy is dependent on a number of factors. Several factors that can significantly impact data accuracy can be monitored in the field: the number of satellite vehicles, Positional Dilution of

Precision (PDOP), signal-to-noise (SNR) and Estimated Horizontal Error (EHE). One should always acquire at least 4 satellites. This gives you a 3D position. More satellites are better than fewer. PDOP relates to satellite geometry at a given time and location. Keep the PDOP as low as possible (ideally, maximum PDOP=4) when collecting mapping data. Some receiver's have the ability to limit collection of GPS data if certain GPS quality measures such as PDOP, SNR and number of satellites are out of range. These are referred to as masking. Most receivers (but not all) give you a field estimate of horizontal error (EHE or EPE). With the Rockwell PLGR and Garmin line of receivers, the EHE (or EPE) has been shown to be a very good indicator of overall positional accuracy (most of the time your accuracy is going to be better than the EHE). In the field, EHE is not presently available on the Trimble GeoExplorer 3.

Positional accuracy for both C/A-Code and carrier-phase types of receivers strongly depends on a process called differential correction. In order to achieve greater accuracy, the differential correction procedure is used to limit Selective Availability (controlled by the Department of Defense (DoD) and Ionospheric/Tropospheric degradation of the satellite signals. Although DoD has now set Selective Availability degradation to zero, Ionospheric / Tropospheric degradation can add from 1 - 7 meters of error to your position. Therefore, differential corrections are required to improve accuracy, maintain positional integrity (confidence), and make a survey tie to a ground-based geodetic survey network.

Differential corrections should be used whenever possible. This removes the greatest source of errors remaining in the GPS error budget. Real-time differential corrections are available through the NDGPS/Coast Guard Beacon System, the WAAS (FAA) satellite based differential system, OmniStar, or a variety of paid private differential services. Post-process differential GPS can be obtained from the NGS base stations available from the web or local community base stations. To be used in a post-processing software.

***Real-time differential corrections should be used whenever possible. This saves both time and money.**

Receiver-Specific Recommended Settings:

Garmin and PLGR units:

1. *EHE*: less then or equal to 12 meters. This will keep you just within the NMAS for a 1:24,000 map, which is the maximum acceptable.
2. *Minimum of 4 satellites (3D)* for every position.
3. *Position Type*: If possible and practical, real-time differentially corrected positions should be collected.

** Note: Because neither of these units operating in autonomous mode can mask for GPS quality, it is up to the user to monitor constantly the Satellite page for quality.

Trimble units Pathfinder Systems (PRO XR's, XRS's and GeoExplorers):

1. *PDOP*: less then or equal to 6 (we recommend starting with a PDOP maximum of 4 and shifting to 5 if data collection is not successful at 4; this will keep you around the NMAS for a 1:5,000 map).

2. *Minimum of 4 satellites (3D)* for every position.
3. *SNR*: less then or equal to 5.
4. *Elevation Mask*: 15.
5. *Antenna height*: be sure to check for correct antenna height setting. This setting should be the typical height at which the antenna will be carried. If the antenna is attached to a pole, it must be located above the user's head and the antenna height setting should be the height of the top of the pole. Wherever possible, the antenna should be clear of any obstructions.
6. *Position Type*: Must be post-processed or real-time differentially corrected.

All GPS units:

1. Check the graphics data collection screen regularly to see if you are getting multi-path or other apparent distortions to the data. Garmin and PLGR's require the user to monitor the screen and stop data collection during poor PDOP or SNR windows. Trimble receiver's set to the appropriate mask will stop collecting automatically.
2. Be aware of the possibility of multi-path interference and use offsets or other methods to keep the antenna away from building overhangs, tall fences or walls, and heavy canopy wherever possible.
3. ALWAYS do differential corrections, either real-time or post processed.
4. Feature settings:

Point

1. *Trimble* - minimum of 30 positions, collected at 1 second interval and averaged.
2. *All Others* - 90 to 120 positions, collected at 1-2 second interval and averaged.

Line/Polygon

- use a 2-5 second interval for walking and for road driving, depending on the road type and speed of the vehicle, force (i.e. wait for) a position at each corner, and use a minimum of 3 positions to define any curve/change in direction.

** Note: If maximum accuracy is required, it is important to sync the collection rate with the base station logging rate. Stations log anywhere from 1 to 30 second data. It is recommended that logging rates to be in multiples of 1 or 5 for best differential corrections. Setting logging rates other than 1 and 5 may reduce the number of positions that are in sync with base data and reduce accuracy.

5. Try to map all features in a single area in a single day or on consecutive days.

Attribute Data

Data dictionaries (e.g. Trimble) or data collection forms (e.g. ArcPAD) are designed to simply, efficiently, and without redundancy, describe features (landscape, biological, cultural, or historical). A data dictionary or form organizes data into types or 'themes' and reduces user error when entering values. It is an efficient use of time and energy to employ this type of data collection. Set up a menu and picklists in a database and load them into the GPS unit or data collection device prior to going out into the field. Create and use a data dictionary or data collection form whenever possible to collected attribute data.

Coordinate Metadata
Record the following:

1. EHE/EPE or maximum PDOP (using 4 satellites)
2. Coordinate datum
3. Coordinate projection
4. Projection Zone, if using UTMs or State Plane

The following parameters should be used in selection of datum and projection:

Projection and Coordinate System

All digital geospatial data should reference the coordinate system appropriate for it's use and it should be documented in the metadata. All spatial data collected or submitted for national, regional, or network NPS programs shall be geo-referenced and provided in a standard projection. Digital geospatial data should be referenced to two coordinate systems--the current standard system used by the individual park (generally UTM, NAD83) and a regional-scale system (Geographic, NAD83). The steps used to get the data into the proper projection must be documented in the metadata. The project manager must specify, approve and document any deviation from these projection standards.

NPS-wide and Regional Data Standard
The standard projection for most NPS regions and national programs is geographic with the following parameters as per Executive Order 12906
(http://www.fgdc.gov/publications/documents/geninfo/execord.html) and the Federal Geographic Data Committee (FGDC) standards:

Datum North American Datum 1983
Spheroid GRS 1980
Units Decimal Degrees

Park Unit Data Standard
The standard projection for most NPS regions and national programs is Universal Transverse Mercator (UTM) with the following parameters:

Projection Universal Transverse Mercator
Datum North American Datum 1983
Spheroid GRS 1980
False Easting 500,000
False Northing 0
Units Meters

Unit Standards for Exceptions

In addition to the systems noted above, several NPS units require additional specific standards for data delivery (e.g., Cabrillo and Craters of the Moon National Monuments). Parks in Hawaii and other Pacific islands will be in the datum and projection specified by each park. Because of their geographic location, the NPS Alaska Region also requires a specific datum and projection as noted below. However, data sets for use regionally and systemwide should be provided in latitude / longitude (decimal degrees) and NAD-83.

Alaska Region

The standard projection for Alaska Region parks uses the following parameters:

Projection Alaska Albers Equal Area
Datum North American Datum 1927
Spheroid Clark 1866
False Easting 0
False Northing 0
Central Meridian -154 00 00
1st Standard Parallel 55 00 00
2nd Standard Parallel 65 00 00
Units Meters

Horizontal / Vertical Accuracy and Precision

All spatial data collected shall be analyzed for their spatial accuracy and shall meet or exceed the National Map Accuracy Standards for the particular scale intended (for more information see http://mapping.usgs.gov/standards/). Longitude and Latitude coordinates for geographic data should be recorded to a minimum 5 significant digits to the right of the decimal point and stored in double precision attribute or database fields. Any calculations done with location data should be done at double precision with the results rounded or truncated to the appropriate propagated error limits. All calculations and processing completed on the spatial data shall be reported in the metadata.

Additional Data Collection Notes

- Positional coordinate data should not be recorded in NAD-27 in the field. Datum conversions should be done as an office, post-process activity using software that utilizes a full NADCON datum conversion in order to assure accuracy and precision.

- When estimating distances, Latitude / Longitude decimal degrees can be used the same as Universal Transverse Mercator coordinates (UTMs). The digit in the fifth decimal place of decimal degrees can be used as approximately a meter.

- Real-time differential techniques should be employed whenever possible for efficiency and time savings.

- The distance between the base station and the remote GPS receiver should be kept to a minimum, preferably less than 150 mi.

Section II

Spatial Data Guidelines

Spatial data, which include GPS generated files, must conform to the following guidelines:

Projection and Coordinate System

All digital geospatial data should reference the coordinate system corresponding to the standard presently in use at the park which, for most parks, will be the correct UTM zone in which the park is found. The datum should be the North American Datum of 1983 (NAD83); the ellipsoid should be the Geodetic Reference System 80 (GRS80); and the units of measure should be meters. The contractor should contact the park's GIS Coordinator for specific instructions and/or refer to the contract or cooperative agreement.

Scale and Spatial Resolution (Vector Data)

New data should not exceed 1:24,000. The contractor should contact the park's GIS Coordinator for specific scale and spatial resolution requirements for vector data or they may be specified in the contract or cooperative agreement.

Scale and Spatial Resolution (Image Data-digital or aerial photography)

The contractor should contact the park's GIS Coordinator for specific scale and spatial resolution requirements for image data or they may be specified in the contract or cooperative agreement. For vegetation classification under the NPS/USGS vegetation classification project, the current standard is 1:12,000 color infrared aerial photographs with 60% overlap and 30% sidelap.

Horizontal and Vertical Accuracy

All data should meet or exceed the following National Map Accuracy standards (Source: USGS Fact Sheet 078-96, September 1997). For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as benchmarks, property boundary monuments; intersections of roads and railroads; corners of large buildings or structures (or center points of small buildings). In general, what is well-defined will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus, while the intersection of two roads or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. This class would cover timber lines and soil boundaries.

> Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error by more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

The following table provides the allowable horizontal accuracy for some common scales:

Scale	Allowable error (feet)
1:40,000	111
1:24,000	40
1:20,000	33
1:12,000	20
1:9,600	16
1:4,800	8
1:2,400	4
1:1,200	2

Attribute Accuracy

At a minimum, an 80% or greater overall thematic attribute accuracy at the 90% confidence interval is required. The contractor should contact the park's GIS Coordinator for specific attribute accuracy requirements or they may be specified in the contract or cooperative agreement.

Spatial Data Formats

At a minimum, all vector data is to be supplied as an ArcInfo coverage and ArcInfo interchange file, e00, compatible with the current version of ArcInfo for the MS Windows operating system. All raster data is to be supplied as an ArcInfo GRID and ArcInfo interchange file, compatible with the current version of ArcInfo for the MS Windows operating system. All digital imagery, such as scanned aerial photographs, is to be supplied as tagged image file format (tiff) files with the proper header file for geo-referencing purposes. The contractor should contact the park's GIS Coordinator for specific data formats or they may be specified in the contract or cooperative agreement. All data should be delivered on CD ROMs compatible with the MS Windows operating system.

Quality Control

When the contractor has completed 10% of the spatial and attribute data development, the contractor must supply the data to the park and appropriate Regional Technical Support Center (RTSC) for quality control purposes. The data must be delivered in conformance to the Spatial Data Formats requirements. Once the park and RTSC have checked the data and found it acceptable, the contractor may continue data development. Once the contractor has completed the work, the park and RTSC must accept the spatial data, attribute data, and Federal Geographic Data Committee (FGDC) compliant metadata before the job is considered complete.

Results of tests used to verify all applicable horizontal, vertical and attribute accuracy measurements should also be provided whenever data is provided to the park and RTSC.

Section III

Voucher Specimen Collection

All vertebrate and vascular plant specimens collected in Northeast Temperate Network parks will be housed at Acadia National Park. Repositories for specimens collected in other Networks in the Northeast Region have not yet been determined. At this time, specimens collected in those parks will be housed at the cooperating University or associated institution with the stipulation that under federal law, all specimens are the property of the NPS and are on long-term loan to the receiving institution. Acquisition of a valid park permit to collect specimens is the responsibility of the cooperator. As well as the preparation of all specimens. The final decision on the collection of voucher specimens will be left up to the discretion of the park, but the collections policy for the Northeast Region I&M Program is as follows. **Cooperators may collect whole specimen vouchers** of amphibians, snakes, mammals, fish and plants **only if**:

1. **Identification of a species is in question.** This may mean that certain taxa, such as fish, may require more intensive vouchering than other taxa.

2. **Or if a particular species has not yet been collected in a park**. A list of existing voucher specimens will be available for each park, and cooperators are required to review this list prior to fieldwork.

Plants and animals that **may not** be whole-specimen vouchered include birds, turtles, large mammals (unless found as road kill) and common plant species. If vouchering is necessary for any of these because no voucher exists for a particular park, photo documentation is required.

Cataloging Specimens

Cooperators must catalog all specimens in the Automated National Catalog System (ANCS). Please contact Sara Stevens (Sara_Stevens@nps.gov) for information on obtaining the ANCS+ software. In some cases, depending upon where the specimens are housed and how many specimens are collected, collection curators will be available to assist cooperators in making the ANCS+ entries.

Vouchering Methods

Photo Documentation

The Northeast Region I&M Program is requiring all cooperators to use non-invasive methods of vouchering, such as color photography, or other signs or remains (e.g. hair samples, scat or tracks) whenever possible. Photographs of a species will be considered a voucher and will be referenced in the NPS NPSpecies database. Photographs taken to provide documentation of a species must be taken with a macro or close-up lens. Photographs should show features used for identification of the species. It may be necessary to take more than one photograph of an individual from different angles. All photographs must be submitted with the pertinent raw data. All slides and photographs must be kept in appropriate protective sleeves. Digital photos must be provided on CD-ROM. Each CD must contain a "Readme" file providing a list of all files, their filenames and description submitted on that CD

Whole Specimens

Voucher preparation will be the responsibility of the cooperator who must have a valid park permit to collect specimens. All vouchers taken on NPS lands, regardless of their repository, will be the property of the NPS. Cooperators will be responsible for accessioning voucher specimens into ANCS+.

Mammalian Collection
In order to minimize disturbance on mammalian populations in parks, photo vouchering and collecting animals where death resulted from either trap mortality or road kill will be priority over euthanizing individuals. Guidelines found in the *Live Animal Capture and Handling Guidelines*, manual no.3, will be followed for proper capture, handling and euthanasia procedures. Guidelines and references for the preservation of voucher specimens can be found in *Measuring and Monitoring Biological Diversity, Standard Methods for Mammals* (Wilson et al, 1996).

Fish Collection
Digital photographs can be an accurate and economical method for vouchering fish specimens. Please follow the guidelines for vouchering fish specimens by Dr. Jay Stauffer and Timothy Stecko from Penn State University. (Please request this document from either Sara Stevens, Sara_Stevens@nps.gov or Elizabeth Johnson, Beth_Johnson@nps.gov). Although it may not be possible to identify all fish specimens from digital photographs taken in the field, these guidelines will be useful for most fish collected. Immature fishes of all species and some of the minnow species, particularly in the genus *Notropis*, need to be collected and properly preserved.

Amphibian and Reptile Collection
For identification purposes, most species of amphibians and reptiles can be adequately confirmed from photographs. Collecting whole specimens of amphibians and snakes will only be allowed as stated above, if a whole specimen does not exist for a park. Turtles may only be vouchered through photo documentation.

Vascular Plant Collection
Species that are common to the park or have already been vouchered should not be collected. Because any collection of specimens impacts a population, it is especially important when collecting rare species to weigh the destructiveness of collection against the amount of information gained. Federal and state Threatened and Endangered plants will not be collected in populations of less than 50 individuals (Elzinga et al, 1998). It is incumbent upon the cooperator to know which taxa are locally or nationally rare or protected, and to be familiar with all federal and state legal procedures for collecting. In small populations, only small portions of plants will be collected if necessary. Cooperators are advised not collect indiscriminately, even in large populations, and to collect only the minimum amount of plant material necessary. (The Plant Conservation Round Table, 1986).

Voucher specimens will be collected during inventory in accordance with collections policies outlined in *NPS Management Policies* ("Museum Objects and Library Materials" and "Preservation of Data and Collections and Protection of Research Potential") and NPS-77, *Natural Resource Management Guideline*.

Section IV

Report Guidelines

Progress Report Format and Content Guidelines

- As requested, submit progress reports double-sided and single-spaced on 8 1/2" x 11" white bond paper and/or in MS Word (most recent version) files as an email attachment or on a CD.
- Use Times New Roman 12 pt font.
- Commence pagination on the first page of text as a footer and centered.
- Begin paragraphs left justified without indentation on the first line and separate paragraphs from each other double-spaced.
- Use title case (i.e. first letter of all words capitalized except articles, prepositions, and conjunctions) for all section headings.
- Use the following style for section headings:

First Order Header [center]
Second Order Header [flush left]
<u>Third Order Header</u> [flush left, underlined]
Fourth Order Header: [flush left, colon, two spaces, continue with text].
Fifth Order Header [flush left, italicize]

- Submit the specified number of copies (usually five) to the designated NPS Key Official on or before the date(s) identified in the research permit, contract, or agreement.
- Depending on the scope of the project, progress reports are usually required quarterly, semiannually, or annually.

<u>Progress Report Content Guidelines</u>

The progress report is a brief, informal, narrative statement of the status of all work accomplished during the period specified, and a summary of work to be performed during the following period. Progress reports should include:

- title page containing the following information: the words "Progress Report"; title of project; investigator name(s), affiliation, and address; NPS contract, agreement, or purchase order number; date of submission; and time period covered by report
- quantitative description of overall progress and significant findings to date
- indication of any current problems that may impede performance and proposed corrective actions
- brief discussion of the work to be performed during the next reporting period.

Final report format and content guidelines

At the completion of a research study, the investigator must submit a draft final report that documents the study methods, results, and conclusions of the entire project as required by the contract. The specified number of copies (usually five to ten) must be submitted to the designated NPS Key Official and the I&M Program contact on or before the date identified in the contract.

Upon submission of the draft final report, the designated NPS Key Official will review the manuscript and seek additional management and scientific review comments from appropriate NPS regional and park personnel and peer members of the scientific community to ensure technical quality and accuracy of information. Review comments and recommended changes will then be returned to the author(s) for consideration and preparation of the final report.

All appropriate comments from draft final report reviews should be addressed and incorporated during the preparation of the final report. Before duplication, a copy of the final report must be sent to the designated NPS Key Official and I&M Program contact for final approval of review modifications and format. Upon approval, a letter quality original, reproducible copy of the final report and the specified number of copies (usually five to ten) must be submitted to the designated NPS Key Official or the I&M Program contact on or before the date identified in the research permit, contract, or agreement. A CD, containing the report in MS Word must be submitted along with the paper copies.

The final report may be printed and distributed as part of an NPS Technical or Natural Resources Report series. Reports printed in these series are not considered formal publications, and the information may be subsequently submitted by authors to peer reviewed journals. The designated NPS Key Official will notify the author of the decision to print the final report in one of the series and will assign the series name and number to be included on the title page. Preprinted front and back covers will be provided for final duplication and distribution.

- Submit all reports double-sided on 8 1/2" x 11" white bond paper and in MS Word (most recent version) files on CD.
- Start all first order sections on a new right hand page.
- Use Times New Roman 12 pt font throughout and avoid bolding text.
- Double-space draft final reports and single-space final reports.
- Allow 1" on all margins.
- Left-justify paragraphs without indentation on the first line and separate paragraphs from each other double-spaced.
- Do not hyphenate whole words at the end of a line, instead use an unjustified right margin.
- Number all pages sequentially at the bottom of the page, centered.
- The initial sections (Table of Contents, List(s) of Figures, Tables, and/or Appendices, Summary, and Acknowledgments) should be numbered sequentially using lower case Roman numerals (i, ii, iii) with numbering beginning with, but not appearing on, the Title Page.
- The main body of the report (beginning with the Introduction) should be numbered sequentially using Arabic numerals (1, 2, 3).
- Blank pages are counted but not numbered.
- Use title case (i.e. first letter of all words capitalized except articles, prepositions and conjunctions) for all section headings.
- Use the following style for section headings:

First Order Header [center]

Second Order Header [flush left]

<u>Third Order Header</u> [flush left, underline]

Fourth Order Header: [flush left, colon, two spaces, continue with text]

Fifth Order Header [flush left, italicize]

Table of Contents

- Include only first and second order section headings in the Table of Contents. Include all first and second order section headings that follow the Table of Contents (i.e. beginning with and including headings for lists of figures, tables, and/or appendices).
- Use title case on all Table of Contents entries.
- Double-space entries.
- Indent second order section headings from first order section headings 7 spaces.
- A space followed by a line of dots followed by a space should proceed from the last word of each entry to a right justified page number.
- Allow page numbers to "stand alone" on the right side of the page by spreading longer entries to additional lines, making sure that each line of the entry is indented to the same starting point as the first word of the entry.
- Repeat the heading (i.e. Table of Contents) followed by "continued" in parentheses at the top and centered for each additional page of the Table of Contents.

List of Figures, List of Tables, and List of Appendices

- Each of these lists must begin on a new right hand page.
- Double-space entries.
- Begin entries with a capitalized label followed by a space then a number (for figures and tables) or capitalized letter (for appendices) then a period then a double space then a title (e.g. "Figure 1. Map of survey area", "Table 21. Estimated larvae in survey area", or "Appendix G. Checklist of butterfly species").
- If there is only one appendix, do not include a List of Appendices page; list it as the last entry in the Table of Contents as "Appendix" with no letter afterward.
- A space followed by a line of dots followed by a space should proceed from the last word of each entry to a right justified page number.
- Allow page numbers to "stand alone" on the right side of the page by spreading longer entries to additional lines, making sure that each line of the entry is indented to the same starting point as the first word of the entry.
- Use sentence case (i.e. capitalize only the first letter of the first word and any proper nouns) for titles.
- Repeat the heading (e.g. List of Figures) followed by "continued" in parentheses at the top and centered for each additional page of the list.
- Consult Tables. 1, 2, and 3 for example lists.

Citing Literature

- Follow the author and year system for citing literature references in the text. If you wish to mention the author in your discussion say, for example, "Wakeley (1954) reported that...". Otherwise, place the author and year within or at the end of your statement, (Wakeley 1954).
- Semicolons separate citations of works by different authors in one set of parentheses (Wakeley 1954; McManus 1957).
- Commas separate several cited works by the same author (Hackett 1970, 1972a, 1972b).
- List all references in the "Literature Cited" section of the report using the Council of Biology Editors (CBE) bibliographic style as outlined in Table 4.

Table 1. Example list of figures

List of Figures

Table 2. Example list of tables

List of Tables

Table 3. Example list of appendices

List of Appendices

Table 4. Literature cited section format

Journal Article Format

First author Surname, Forename initial Middle initial(s)., and Second author Forename initial Middle initial(s). Surname. Publication date. Article title. Journal title. Volume number(Issue number):page number-page number.

Example

Kinbote, C. V., and D. N. Haze 1948. A new species of Cyclarus Nabokov. The Entomologist. 81(1027):273-280.

Book Format

First author/editor Surname, Forename initial Middle initial(s)., and Second author/editor Forename initial Middle initial(s). Surname, editors [if applicable]. Publication date. Title of book. Edition number. Publisher, City of Publication, State/Country of Publication. number of pages pp.

Example

Knight, S. V., and V. N. Darkbloom, editors. 1998. Butterfly identification in our National Parks. Second edition. Blackwell Scientific Publications, Ithaca, New York. 512 pp.

Report Format Example

First author Surname, Forename initial Middle initial(s). and Second author Forename initial Middle initial(s). Surname. Publication date. Title of report. Report Identification Number. City of Publication, State/Country of Publication. number of pages pp.

Example

Quilty, C. V., and A. N. Vokoban. 1961. A study of Lepidoptera at Shenandoah National Park. National Park Service Technical Report NPS/SHEN/NRTR-91/016. Luray, Virginia. 161 pp.

Table 4. Literature cited section format (continued)

Chapter in Book or Paper in Conference Proceedings Format

First author Surname, Forename initial Middle initial(s)., and Second author Forename initial Middle initial(s). Surname. Publication date. Title of chapter or paper. Pages page number-page number in First editor Forename initial Middle initial(s). Surname and Second editor Forename initial Middle initial(s). Surname, editors. Title of book or conference proceedings. Publisher, City of Publication, State/Country of Publication.

Chapter in Book Example

Pnin, P. V., and H. N. Humbert. 1999. Yesterday's caterpillar: A re-examination of Lepidoptera morphology at Hopewell Furnace National Historic Site. Pages 131-313 in .S. V. Odon, and K. N. Krug, editors. Insect Studies in National Parks of the Eastern United States. University Park, Pennsylvania

Paper in Conference Proceedings Example

Pnin, P. V., and H. N. Humbert. 1999. Yesterday's caterpillar: A re-examination of Lepidoptera morphology at Hopewell Furnace National Historic Site. Pages 131-313 in .S. V. Odon, and K. N. Krug, editors. Insect Studies 1998-1999. American Society of Entomologists. University Park, Pennsylvania

Thesis Format Example

Author Surname, Forename initial Middle initial(s). Date of thesis. Title of thesis. Type of thesis. University. number of pages pp.

Example

Zembla, V. N. 1997. A comparative ecological study of Madeleinea mashenka and Madeleinea lolita in Northeastern National Parks. M. S. thesis, Cornell University. 242 pp.

Figures and Tables

- Figures and tables should have brief descriptive titles.
- Numbers and titles for figures should be below the figure and left justified.
- Numbers and titles for tables should be above the table and left justified.
- Explanatory information and keys to symbols should be placed in the legend to the figure or as a footnote at the bottom of the table.
- The title, heading, legend, and footnotes must contain all the information the reader needs to
- understand a table or figure without referring to the text.
- All figures (including maps and photographs) and tables should be in digital format as part of the final document. If line drawings and artwork are necessary, they must be in high-contrast black and white and of a professional reproducible quality.
- Figures and tables should not be placed on a page with text but should be on their own
- numbered page immediately following the page (double-sided) in which they are referenced.
- Use sentence case for all figure and table titles.
- Figures and tables, respectively, are numbered sequentially with Arabic numerals in the order of their presentation in the text
- Every table and figure must be cited in the text (e.g. "(Table 1)" or "...in Figs. 2 and 3").
- For figures and tables which are more than one page, repeat the figure or table number and title
- followed by "continued" in parentheses, for each additional page.

Appendices

- Each appendix must begin on a new right hand page
- Appendices are labeled sequentially with capitalized letters (e.g. "Appendix A", "Appendix B", etc.) followed by a brief concise title in sentence case at the top of the page and centered.
- A single appendix is labeled "Appendix."
- If possible, the title should appear on the same page with the appendix material; if not, the title can be placed centered on the top of the preceding right hand page.
- For appendices that are more than one page, repeat the title at the top and centered, followed by "continued" in parentheses, for each additional page.

Measurement Units

- All measurement units must be metric.
- Include U.S. equivalent measurements parenthetically.
- Use abbreviated standard units of measure when with a numeral, whereas, units of measure are to be spelled out if no quantity is given (e.g. "10 m" or "...meters").
- Retain only the final unit of measure in a series (e.g. 10 to 15 kg).
- Use a "/" for ratios with numbers (e.g. 10 deer/ha) but use "per" for ratios without numbers (e.g. deer per hectare).

Numbers

- Numbers from one through nine are written out; numbers above nine are expressed as numerals except when first word of sentence. Ordinal numbers (e.g. second, 23rd) are treated the same.
- Physical measurements (length, width, distance, area, volume, decimals, percentages, degrees, symbols, latitude/longitude, fractions over one) and time (days, years) are always expressed as numerals.

Taxon Names

- Use common species names of plants and animals initially followed with scientific names parenthetically; thereafter, only the common name is necessary.
- If a large number of species are referred to in the text, a reference list of common and scientific names must be included as an appendix.

Copyrighting

Authors are responsible for obtaining written permission for use of any copyrighted figures, tables, graphs, and information.

Errors

Authors are responsible for conducting an editorial review of the draft report to ensure: clarity; proper grammar, spelling, and punctuation; accuracy and completeness of all numbers, tables, figures, and references; and adherence to these format and content guidelines.

Final Report Content Guideline

Abstract and Key Words

The abstract should present the purpose of the study, general materials and methods (including, if any, the scientific and common names of organisms), summarized results, and major conclusions, in one or two paragraphs. Do not include any information that is not contained in the body of the paper.

Include a list of two to four keywords beneath the abstract. The abstract and keywords must be together on no more than one page.

Summary

This "stand alone" section should summarize the prominent facts discussed in the report and the conclusions reached in relation to research objectives. It should be as brief as possible, yet cover the subject in a clearly written, non-technical style so that, on its own, this section tells the reader what the project was about and what conclusions were made. This section is often removed from the report and used by the Park Superintendent to inform legislators, public individuals and organizations, and NPS park, regional, and Washington Office staff of the completion and results of the project.

Acknowledgments (optional)

Briefly acknowledge those who directly helped with research or writing. Acknowledgments of typists, illustrators, editors, and referees may be included, but generally are discouraged. Use only forename initials with surname(s) and do not include professional titles or academic degrees.

Introduction

The introduction should include the hypotheses and purpose of the investigation. Provide a justification(s) for the significance of this study (conservation implications, scientific need, etc…) Provide the objectives, conditions under which the study was conducted, the general plan of treatment of the subject, and summary of previous work accomplished (literature review) that relates to the project and how the present work will help to clarify or expand knowledge in this general area. All background information gathered from other sources must be appropriately cited (see Literature Cited).

Study Area

This section should include the location and a description of the park (size, geographic reference i.e. island, peninsula, surrounded lands, elevation, etc…) and its resources/ecological importance.

The study area within the park should be described in detail. Include a justification for selection of the study area(s) for this project. Include a detailed map with geo-reference points for repeatability. Describe habitat types and their boundaries within the study area. Describe who and how the habitat types were defined and chosen (vegetation classification, maps, field guides, aerial photos?). Describe the dominant vegetation associated within the overstory and understory of each type. Precise definitions of habitat types listed should be included in the Appendix with citations as needed.

Methods

The methods should be appropriately documented so that the investigation can easily be repeated. Present a detailed explanation of the methods, materials, and analytical techniques that were used in the field, laboratory, and office during the study. Describe how, when, where, and by whom the data were acquired for the investigation. For clarity and ease of reading, the following sections are recommended.

Species Data:

This section should include a description and discussion of survey techniques used. If well-known methods were used without changes, simply name the methods. If modified standard techniques were used, describe the changes. If multiple methods were used, list each method followed by a descriptive paragraph about that method.

For example:

- Haphazard Visual-encounter—followed by protocol description.
- Frog-call surveys-followed by protocol description

All materials and equipment used should be described in the narrative and include the make and model for repeatability purposes.

If measurements were taken on captured animals describe the methods used and measurements taken. If animals were marked, describe the marking technique and identification system.

Voucher Data:

Provide a description and discussion of collection techniques. Include a description of measurements taken when specimens were collected. Provide all repository information, including institution and contact information for the person curating the collection.

If photographs were taken, provide the make, model and type of camera. Decribe how individual species were identified in each photo.

Site and Survey Location Data:

If a GPS unit was used, provide all data collection techniques and the make and model of the GPS unit. How were coordinates recorded? If ortho-photos were used, described how the photos were acquired and how locations were determined from the photos.

Data Analysis:

Describe how data were analyzed and what statistical tests were employed. Describe the process used for determining whether the data, both spatial and tabular, met the data quality objectives and, if not, what corrective actions were taken. Detailed information about QA/QC procedures for data collection, verification, and validation should be placed in an appendix if it is too lengthy and detracts from the main body of the text.

Results

Summarize data using narrative text, and where appropriate include tables and figures. Present findings that either support or provide evidence against the hypotheses or that answer the question(s) presented in the "Introduction". Data assembled in tables and/or figures should supplement the text and be presented in a clear understandable format. Do not present raw data. If tables and/or figures are used, they must be accompanied by descriptive text. Do not extensively repeat the data you have presented in tables and figures, in the text. Extensive species lists should be placed in an Appendix. Basic descriptive statistics (sample size, percentages, mean, median, maximum, and minimum) are appropriate when clearly presented. Avoid technical discussions of complex statistical testing; instead refer readers who may be interested in this type of information to an appendix.

Discussion

Present a clear interpretation of the data addressing the hypotheses, objectives, or purpose for which the study was conducted. Interpretation of the data in terms of patterns that were observed, relationships among variables that are important and correlations between variables that are discernible should be presented in this section. The author should include explanations of how the results differed from those hypothesized, or how the results were either different from or similar to those of related studies. "Negative" results should also be discussed and may reveal important findings.

Other findings may be reported in this section that would be of general interest to the scientific community.

Conclusions

Provide a specific and detailed summation of the conclusions of the research. In some instances, this is one of the few parts of the report that park managers will read. If the research was initiated due to specific park management needs, management implications should be emphasized and thoroughly discussed. Include recommendations on how this research can be applied to park resource management and additional work that may be conducted to answer relevant questions. For example: Should precautionary buffer zones be placed around a species habitat or should roads or trails be closed at specific times of the year and why? Do you have recommendations for further study of a particular species or immediate protection of a habitat or species and why? How frequently should this park be reinventoried for the taxa you worked on? Are there particular areas/species that need more frequent monitoring/inventorying than others, why?

Recommendations regarding policy positions of the agency should not be included. If desired, recommendations of this nature should be covered in a special supplementary report separate from the scientific report.

Table 5. Title page format

FLORA OF PETERSBURG NATIONAL BATTLEFIELD

Michael S. Rosenweig
and
Duncan M. Porter

Technical Report NPS/PHSO/NRTR-98/075

Department of Biology
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24061-0324

January 1991
Revised September 1993

Cooperative Agreement
4000-9-8014
Supplemental Agreement 4

National Park Service
Northeast Region
Stewardship and Partnerships
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

Data Dictionary Example

A data dictionary is part of a database management system that provides specific descriptions of the data housed in the database.

Format Guidance:

DATA DICTIONARY

Data Field and Attribute Definitions

BIOLOGICAL INVENTORY

Final Report Title: Comprehensive Inventory Program for Birds at Six Pennsylvania National Parks (ALPO, EISE, GETT, HOFU, JOFL, VAFO), 1999-2001
Database Filename: VAFO_Birds_2002.mdb

TABLE INDEX

tblEvents

Field Name	Field Type	Field Width	Field Description
EventID	Text	255	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Park	Text	50	Park Code. See tluParkName.
GeneralSurveyType	Text	50	Type of Biological Inventory - BIRDS
SpecificSurveyType	Text	50	Type of Bird Survey – OWL, POINTCOUNT, RAPTOR, RIPARIAN, ROAD, SHRIKE

Field Name	Field Type	Field Width	Field Description
StartDate	Date	8	Date (mm/dd/yy) when sampling began
StartTime	Date	8	Time (hh:mm) when sampling began. Start times were not recorded for Shrike and Road Surveys.
Visit	Long	4	Either the first, second or third visit during a specific season of a particular year.
Season	Text	50	Fall (25 Aug - 10 Oct), Winter (1 Dec - 15 Mar) , Spring (15 Apr - 25 May), Breed (25 May - 15 Jul)

tblLocations

Field Name	Field Type	Field Width	Field Description
LocationID	Text	255	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
ParkCode	Text	50	4-character Park Code. See tluParkName
Project	Text	10	Code for component of program (Weather, Birds, Fish, Veg Plots, etc.)
SurveyType	Text	50	Type of survey conducted at location (Owl, Point Count, Raptor, Riparian Bird, Road)
SurveyLocation	Text	50	Survey location number unique to survey type.
StartUTMX	Double	8	UTM X (easting) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)
StartUTMY	Double	8	UTM Y (northing) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)

tblBirdEvents

Field Name	Field Type	Field Width	Field Description
EventID	Text	50	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Temp	Double	8	Temperature in degrees Fahrenheit.
Wind	Double	8	Wind speed in miles per hour.
Clouds	Double	8	Percentage cloud cover.
Precip	Double	8	Indication of precipitation. 0 = none and 1 = light snow during winter or mist to light drizzle during spring, breed, or fall.
SnowDepth	Long	4	Snow depth in centimeters.

tblLocOverstory

Field Name	Field Type	Field Width	Field Description
LocOverstoryID	Long	4	Unique autonumber assigned to each record in the table
LocationID	Text	50	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
Observer	Text	50	Last name(s) of the investigators that conducted the survey.

Field Name	Field Type	Field Width	Field Description
Species	Text	255	Common or generic name of the overstory tree.
DBH	Double	8	Diameter at breast height in inches of each overstory tree within a 38 foot radius of the point center. Overstory trees were > 5 feet tall and > 2.9 inches diameter at breast height.
Date	Date	8	Date that vegetation sampling occurred.

tblOwlSurvey

Field Name	Field Type	Field Width	Field Description
LocationID	Text	255	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
EventID	Text	255	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Species	Text	255	Four letter species code identifying the common name of a bird. Bird common names and their associated species codes are found in the tluBirdSpecies table. * = none detected.
Individuals	Long	4	Number of individuals detected. 0 = none detected.
Detection	Text	50	Method of detection. V = visual, S = song, C = call, and * = no data collected.

tblPointCountSurvey

Field Name	Field Type	Field Width	Field Description
PointCount SurveyID	Long	4	Unique autonumber assigned to each record in the table
LocationID	Text	255	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
EventID	Text	255	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Species	Text	50	Four letter species code identifying the common name of a bird. Bird common names and their associated species codes are found in the tluBirdSpecies table. * = none detected.
Individuals	Long	4	Number of individuals detected. A blank space = none detected.
Distance	Long	4	Distance that the bird(s) were from the point center. A blank space = not applicable.
Detection	Text	50	Method of detection. V = visual, S = song, C = call, and * = no data collected.
Interval0-3	Double	8	0-3 indicates the initial three minutes of the point-count survey. 0 = not first detected during this time period and 1 = first detected during this time period. A blank space = no data collected.
Interval3-5	Double	8	3-5 indicates the three to five minute time period of the point-count survey. 0 = not first detected during this time period and 1 = first detected during this time period. A blank space = no data collected.
Interval5-10	Double	8	5-10 indicates the last five minutes of the point-count survey. 0 = not first detected during this time period and 1 = first detected during this

Field Name	Field Type	Field Width	Field Description
			time period. A blank space = no data collected.